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ABSTRACT

The monograph summarizes characteristics of effective instruction of mildly handicapped and non-handicapped students by focusing on two literature areas: Instructional Psychology and Models of School Learning. The review on instructional psychology covers the following areas: definitions of instruction, principles of learning, models of the teaching-learning process (J. Lembo and M. Dembo), theories of instruction (the Gagne Briggs theory, mastery learning theory, prescriptive theory, R. Case's theory, and E.Z. Rothkopf's theory), and instructional stages. The Models of School Learning discussion stresses how instructional effectiveness is viewed in each of the following six models of school learning: John Carrol's model of school learning, Benjamin Bloom's mastery learning model, A. Harnischfeger and D. Wiley's model, the Model of Classroom Processes used in the Instructional Dimensions Study, the Model of Classroom Instruction of the Beginning Teacher Evaluation Study, and N.L. Karweit's Dynamic Model of Classroom Learning. Similarities between the models include: emphasis on learning as a complex amalgamation of factors and emphasis on the role of time. Differences include focusing on different levels (the individual student, the classroom, or both) of instruction and different emphases on the relationship of critical variables of instruction. Fifty-eight references are appended. (DB)

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MONOGRAPH NO. 2

INSTRUCTIONAL PSYCHOLOGY AND MODELS OF SCHOOL LEARNING: IMPLICATIONS FOR EFFECTIVE INSTRUCTION OF HANDICAPPED STUDENTS

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INSTRUCTIONAL ALTERNATIVES PROJECT

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Abstract

This monograph is a summary of characteristics of effective instruction and their relationship to learning from two literature areas: Instructional Psychology and Models of School Learning. Beliefs and theories held by cognitive and educational psychologists about the essential components of effective, efficient instruction and principles of learning are reviewed. Six models of school learning are described, with particular emphasis on how instructional effectiveness is viewed within each model. Instructional variables important for planning and implementing effective instruction for mildly handicapped students are described and discussed.

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Instructional Psychology and Models of School Learning: Implications for Effective Instruction of Handicapped Students

The Instructional Alternatives Project is a series of investigations aimed at assessing the effectiveness of alternative methodologies for increasing academic engaged time and academic outcomes for mildly handicapped students. The purpose of this monograph is to summarize what literature reviews and selected studies in instructional psychology and school learning models have to say, or suggest, about effective instruction for mildly handicapped students. These areas are just two of many that provide a basis for characterizing the qualitative nature of instruction for handicapped students.

For the past decade, educational psychologists have paid considerable attention to the relationship between time and school learning. Building on the seminal work of Carroll (1963) and subsequent work by Bloom (1974), Harnischfeger and Wiley (1976) and Wiley and Harnischfeger (1974), researchers have conducted major investigations of the relationship between opportunity to learn (variously called academic engaged time, academic learning time, academic responding time, or time on task) and instructional outcomes. Now, in the past few years, the need to go beyond quantitative measures of engaged time to investigate what students do during engaged time (i.e., the qualitative nature of instruction), increasingly is recognized. Ours is one such effort.

Several comprehensive reviews of time research findings and issues have been written (Anderson, 1984a; Graden, Thurlow, & Ysseldyke, 1982; Karweit, 1983). In general, researchers have demonstrated: (a) school and teacher differences in time allocated to instruction exist; when aggregated over the school year, large differences between schools and classrooms in opportunity to learn in various curriculum areas result; (b) students spend a relatively small

percentage of the school day actively engaged in academics; (c) the percentage of time engaged varies considerably across classrooms and across individual students within classrooms, resulting in large differences between students in time actively involved in learning; (d) engaged time rates depend on a variety of organizational factors (classroom management, class size, interruptions), content area, and the point in time during the instructional period; and (e) engaged time is consistently though moderately related to student achievement. In addition to the tremendous variation in use of classroom time, data suggest that additional time used to make up for ineffective instruction is negatively correlated with achievement (Frederick & Walberg, 1980; Karweit, 1983).

Time-based research is criticized on several counts. First, it is said that it tends to draw attention away from the quality of learning and to the quantity of time spent learning. Confrey (1981) argues that what occurs during a time period, not simply accumulation of time, is most critical for student learning. Thus, assignment of "busywork" can result in high time-on-task rates for students without concomitant increases in learning. Karweit (1983) criticizes time research because: (1) time appears to be at most a moderate predictor of achievement, (2) teacher, student, and classroom variation in engaged time may not be as easily altered as suggested by Bloom (1980), and (3) large increases in instructional time may be required for reasonably small changes in achievement. In her review and re-analysis of studies of engaged time and achievement, she concluded that there is a consistent, but low, positive correlation ($r = .09$ to $.43$) between the two when initial ability is controlled. Thus, time and other variables share substantial common variance.

In general, time-based studies of school learning result in the overall conclusion that time is one factor but not the sole factor, producing or

limiting student achievement. Simply stated, increased time is a necessary, but not sufficient condition for improving student achievement. Several researchers echo the need to investigate other factors. Consider the following:

> The value of future classroom research will improve if more attention is placed upon the quality of instruction and if research becomes more integrative, examining the teacher, students, and particular curriculum tasks in specific contexts. (Good, 1983, p. 129)

> Clearly it is the quality more than the quantity of schooling which best serves as an educational and research focus. Quality of schooling includes not only time on task, but time well spent. It also includes, however, time spent on teaching practices such as encouragement, corrective feedback with guidance, small group discussions, individualization, and students involvement in their own education; but not idle praise, corrective feedback without guidance, rambling verbal interactions, busywork as a controlled device, or token student making. (Sirotnik, 1983, p. 26)

> We need to move beyond the now well established relation between time on task/student engagement/teacher management skills and student learning...at this point we no longer need to replicate these findings; instead we need to go beyond them in order to observe other relations. (Brophy, 1979, p. 749)

The qualitative nature of instruction has not received the attention for handicapped students that it has for nonhandicapped students. Since a primary goal of the Instructional Alternatives Project is to document the qualitative nature of instruction for handicapped students, a necessary first step was to review the relevant literature, literature that might directly address the issues related to instruction for handicapped students, or that at least would provide insights that might be relevant to students in the special education population.

In this endeavor, seven general areas of literature were identified. They are as follows:

Instructional Psychology
Models of School Learning
Effective Schools
Effective Instruction
Teacher Effectiveness

Teacher Decision Making
Student Cognitions

The first two areas are summarized in this monograph. Other areas are summarized in other monographs. In each literature review, we identified those factors that individuals say are important or that research has documented empirically to be related to positive academic outcomes. Based upon these literature reviews, over 100 factors were generated. These factors, organized into environmental, instructional, and student characteristics, were studied and the decision was made to focus on an analysis and description of instructional factors for assessing the qualitative nature of instruction. The procedure used to develop a scale for this purpose is described in Monograph No. 1 (Ysseldyke, Christenson, McVicar, Bakewell, & Thurlow, 1986).

In this monograph, literature reviews and selected studies are summarized in the areas of instructional psychology and models of school learning. The monograph concludes with a summary of the contributions each literature area makes in characterizing the nature of instruction and in identifying important variables for promoting positive student learning outcomes.

Instructional Psychology

Relevant literature from instructional psychology is discussed in this section. In compiling this review, several types of publications were read. Major emphasis was given to articles describing beliefs and theories held by cognitive and educational psychologists about the essential components of effective, efficient instruction.

During the past 25 years, instructional psychology has been evolving as a new discipline aimed toward improving instruction. Two patterns that contribute

to confusing terminology during this "developmental" period have emerged. First, different theorists use different terms to refer to the same phenomenon or they use the same term to refer to different phenomena. Second, the knowledge that has been generated so far has tended to be piecemeal, and instructional researchers have tended to develop independent "knowledge bases." Instructional psychology draws from different areas, including learning theories, educational psychology, instructional models, theories of instruction, and instructional design. In this section we make no attempt to review comprehensively the independent knowledge bases. The interested reader is referred to a recent book, Instructional-Design Theories and Models: An Overview of Their Current Status (Reigeluth, 1983) and reviews by Resnick (1981) and Gagne and Dick (1983). This section is organized into five parts: (1) definitions of instruction, (2) principles of learning, (3) models of the teaching-learning process, (4) theories of instruction, and (5) instructional stages.

Definitions of Instruction

Instruction is defined in varied ways. However, it generally is described as a set of events or activities that affect students in such a way that learning is facilitated. Most definitions emphasize control of external events or conditions by an individual (i.e., the teacher) and define instruction as independent of the specific content being taught. According to Gagne (1977), instruction is defined as the set of events external to the learner that are designed to support the internal processes of learning. Engelmann (1980) underscores the importance of verbal communication and an effective match of external conditions with student capabilities in order to facilitate learning.

While manipulation of external events or conditions is emphasized, the student's internal processes are recognized in most definitions (cf. Skinner, 1984). Cognitive psychologists have made several contributions to our understanding of the role of internal processes in instruction (Calfee, 1981; Case, 1978; Gagne & Dick, 1983; Glaser, 1982).

Sometimes a distinction is made between instruction and teaching. Instruction is the preferred term because many events, including those directly influenced by the teacher, affect student learning outcomes. Various media, such as printed material, pictures, television programs, tapes, and audio visual aides are used in instruction. Despite this distinction, teaching cannot be separated from instruction (and often is not) because of the teacher's essential role in the arrangement and management of external events. Albeit a singly important one, teaching is considered as one form of instruction.

According to Glaser (1982), instructional psychology with its current emphasis on cognitive psychology (recently labeled cognitive science) focuses on the acquisition of intellectual competence. He discusses the current status of the field in terms of four major components of a psychology of instruction: the nature of the competence to be attained, the initial state of the learner, the transition process or conditions for learning that foster acquisition of competence, and assessment and monitoring of the characteristics of the new knowledge or skill.

The recent emphasis on cognitive science is opposed by Skinner (1984), who argues that current problems in schools could be solved if students learned twice as much in the same time and with the same effort. He contends that it has been shown that student achievement can be improved dramatically when the

goals of education are clarified and stress basic skills, when students are allowed to progress through the curriculum at their own rate, and when programmed instructional materials are used to maintain student motivation.

Glaser (1982), on the other hand, proposes that a theory of teaching and instruction will emerge from the growing body of research on classroom practices. He suggests that such variables as allocation and efficient use of time, the structure of classroom management, the nature of teacher feedback and reinforcement to the student, the organizational pattern of teacher-student interaction, the relationship between what is taught and what is tested, the degree of classroom flexibility required for adapting to the learner's background, and the details of curriculum materials need to be a part of a theory of teaching and definition of instruction.

Principles of Learning

Systematic application of principles of learning to instruction is a major theme in educational psychology. Contiguity, repetition, and reinforcement are time-tested principles derived from learning theory and research. When teachers create situations that include these principles, an effective learning situation is not necessarily guaranteed. Newer perspectives on systematic application of learning principles, including the role of prior learning, motivation, and the student's attitude toward and confidence in learning are other important factors for promoting positive academic outcomes.

Bugelski (1971) argued that teachers need to systematically apply eight principles of learning; these are cited frequently in introductory Educational Psychology texts. Instruction should be designed to include these principles. A generalization illustrating each principle follows:

1. Readiness for learning. Prior to effective instruction, some diagnosis must be made about what the student already knows.

2. Motivation to learn. Teaching at the appropriate instructional level enables the student to experience success.

3. Knowledge of results. Self-reinforcement regarding successful answers affects learning.

4. Immediate reinforcement. Teacher feedback regarding the accuracy of the student's response is critical for learning.

5. Practice and repetition. Review of the previous lesson, specific drill periods, and specific, periodic reviews, influence learning.

6. Overlearning. Materials presented in varied formats and media influence learning.

7. Positive transfer of training. Opportunities to apply the new, novel skill in a different situation influence learning.

8. Progression of materials. Effective learning occurs when materials are systematically sequenced from simple to complex or from concrete to abstract ideas.

Models of the Teaching-Learning Process

Two models of the teaching-learning process (Dembo, 1981; Lembo, 1969) illustrate the interactive nature of instruction and outline conditions that should be present in order to optimize learning outcomes for students.

Lembo's model. Lembo (1969) proposes that an adequate instructional model is comprised of three teacher decision-making factors: diagnostic, prescriptive, and normative. The diagnostic factor represents the way the teacher identifies the student's present level of functioning, the appropriate kinds of instructional objectives and activities for the student's level of ability and style of responding, and the way problems resulting from unaccomplished instructional activities are handled. The prescriptive factor includes the rationale and guidelines used for establishing specific learning

conditions in the classroom. Finally, the normative factor refers to the way in which the teacher determines the extent to which the learning goals have been met. Therefore, a viable model of instruction must include clear specification of procedures for:

- identifying relevant learner characteristics and readiness levels
- selecting appropriate instructional objectives and sequences
- using appropriate instructional methods, including sequenced materials, teacher questioning, and motivating conditions
- assessing achievement of instructional objectives during and at the end of each unit of instruction
- formulating and testing teacher hypotheses about student performance.

The goal in Lembo's model is constant improvement of the student's instruction by arriving at better learning prescriptions for subsequent learning units.

Dembo's model. The role of the teaching objective is paramount in Dembo's (1981) nine step interactive model. According to him, the teaching-learning process facilitates achievement gains for students when: (a) there is a teaching objective, (b) classroom instruction is focused on achieving the established objective, (c) the objective is appropriate for the student, and (d) the student masters the objective. In addition, the teacher's role in facilitating or interfering with student learning, in terms of dealing with problems that occur during the lesson, is believed to have a profound effect on students' achievement.

Dembo identifies three critical points for characterizing instruction: before, during, and after teaching a lesson. There is much similarity between the Dembo and Lembo approaches for characterizing an effective teaching-learning

process. Specifically, Dembo's time before instruction addresses organization of the appropriate lesson (similar to Lembo's diagnostic factor), time during instruction focuses on teacher facilitation of student progress (similar to Lembo's prescriptive factor), and time after instruction allows for evaluation of the mastery of instructional objectives (Lembo's normative factor).

Theories of Instruction

Gagne and Dick (1983) summarize five theories of instruction in their article reviewing the instructional psychology literature. These theories are described here. In each case, the theory also is defined as a model of instructional design. Theories of instruction are attempts to relate specific instructional events to learning processes and outcomes, drawing upon learning research and theory, whereas models of instructional design identify efficient instructional procedures.

Gagne-Briggs theory. Based upon the work of Gagne (1977), conditions of learning are emphasized in the Gagne-Briggs theory of instruction (Gagne & Briggs, 1979). These conditions include those internal states and external events required for learning. Internal conditions include motivational states and learning processes (e.g., prior knowledge, processing, storing, and retrieving information). The core of this theory is in the way instruction is managed via nine events. Specifically, these events are conceived as occurring in an approximately ordered sequence as follows: (1) gaining attention, (2) informing learner of the objective and expected outcome, (3) stimulating recall of prerequisite learnings, (4) presenting the stimulus material, (5) providing learning guidance, (6) eliciting the performance, (7) providing feedback, (8) assessing the performance, and (9) enhancing retention and transfer.

This theory is very complex. Gagne and Briggs (1979) propose that five learning outcomes (verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes) must be considered in order to understand learning as it occurs in instructional settings. Internal and external conditions must be specified separately for each learning outcome. A different set of conditions for optimizing learning retention and transferability is required for each learning outcome. Examples for applying each of the nine instructional events are provided by Reigeluth (1983) and appear in Table 1. For example, the purpose of communicating the objective to the student is to provide a reference from which the student judges mastery and learning. Imprecise descriptions of the content to be covered, such as "today you will learn about subtraction" do not specify or communicate the learning outcome. Gagne (1977) contended that the design of instruction is more critical for student learning than some of the more widely known psychological principles such as reinforcement. Hence, the Gagne-Briggs theory underscores the importance of "how" each of the nine events is presented to the learner.

Mastery learning theory. In the mastery learning model, "alterable variables" for schooling (e.g., the student's cognitive and affective entry behaviors and factors related to quality of instruction, specifically student participation and corrective feedback) are emphasized. Bloom's emphasis on the study of alterable variables as opposed to the stable variables of aptitudes or abilities, has resulted in a significant number of research findings on the effects of cognitive prerequisites, distinctive cues, learner practice, and corrective feedback on student achievement (Bloom, 1976). Anderson's (1976) study supported Bloom's hypothesis that individual differences in achievement

Table 1

12 Examples of Application of Gagne-Briggs Nine Instructional Events

1. Gaining Attention. An initial task in any instruction is to gain the learner's attention so that other instructional events can function properly. For example, in designing instructional motion pictures on inherently dull subjects, May (1965) suggested that two versions of the films might be produced. The first version would be designed to gain the viewer's attention, using many embellishments and rapidly changing stimuli, whereas the second version would have few special effects and would develop at a slower rate to enable the viewer to process and learn the information presented.

2. Informing the Learner of the Objective. The purpose of communicating the objective to the learner is to enable the person to answer the question: "How will I know when I have learned?" (Gagne & Briggs, 1979). Too often students are given an imprecise description of the content to the covered; for example, consider a biology teacher who introduces a unit on genetics by saying, "One thing you will learn about is homozygous and heterozygous genotypes." Such a statement does not communicate what the learning outcome will be. Will the students be able to state definitions of the concepts heterozygous and homozygous genotypes, or will the learners be able to classify genotypes as homozygous or heterozygous and name the kind of resulting phenotype?

3. Stimulating Recall of Prerequisite Learnings. Essential capabilities must be available for recall before new learning can occur. Sometimes this event can be accomplished by the instructor simply reminding the individual of previous learning: "Remember that you learned the difference between the numerator and denominator in a fraction. Now we can learn how to find common denominators." At other times, a formal review may be required: "Class, before we learn how to look up words in a dictionary, let's review how to alphabetize words that have the same first two or three letters."

4. Presenting the Stimulus Material. The range of stimulus materials is as varied, of course, as the range of instructional objectives. Stimulus material may be in the form of statements of verbal information ("Here are the essential provisions of Public Law 94-142, The Education for All Handicapped Children Act of 1975."); examples of concepts ("This is a monocotyledon plant; this is a dicotyledon."); or demonstrations of motor skills ("Watch this demonstration of how to high dive."). The actual form of the stimulus material will also be determined by the subject matter and such factors as the characteristics of the learners and the media used.

5. Providing Learning Guidance. The function of learning guidance is to help the learner acquire the particular capabilities specified in the objectives. For example, in teaching a concept, the learning guidance would ensure that the learner understood the critical attributes of the concept; in teaching a procedure to follow for diagnosing trouble in a piece of malfunctioning equipment, the learning guidance might be in the form of a checklist to teach the steps to follow and the sequence in which they are performed.

   Some learners require more guidance than others, a principle utilized in programmed instruction through its provision of extensive branches.

6. Eliciting the Performance. In order to determine whether a learner is in fact acquiring a particular internal capability, it is important to have the learner perform an overt action. The instructor may ask a question or give directions to elicit a response: "Class, is this an example of a simile or a metaphor?" or "Here are some problems to solve."

   It is important that the response called for is the same as that required in the objective so that the learner is getting practice that is relevant to the desired learning outcome. If the terminal objective specifies that the learner will be able to classify statements as similes or metaphors, it would be inappropriate to ask the individual how to spell the words simile and metaphor.

7. Providing Feedback about Performance Corrections. Providing feedback is a crucial instructional event. To be most effective, feedback should be informative. Rather than writing on a composition "needs improvement," the experienced English teacher explains the kinds of improvements that are required: "These sentences are not parallel," "These sections are redundant," or "The pronouns and their antecedents do not agree."

8. Assessing the Performance. The purpose of this event is to determine whether the learner obtained the objective and can consistently perform what was intended. A variety of test items may be employed and used over a period of time. Of course, the assessment should be congruent with the objective.

9. Enhancing Retention and Transfer. Instructional designers cannot assume that learners will be able to transfer learning from one situation to another; such retention and transfer should be included as part of the instruction. For intellectual skills, providing spaced reviews helps. For verbal information, providing linkages between information learned at different times is recommended.

Note: From Instructional-Design Theories and Models: An Overview of Their Current Status (pp. 91-92) by C. Reigeluth, 1983, Hillsdale, NJ: Lawrence Erlbaum.

can be reduced over time as a result of quality instruction. When given quality instruction according to mastery learning methods, specifically corrective feedback and more time to reach mastery, eighth grade low achieving students reduced their need for extra on-task time in matrix arithmetic assignments from an additional 66% on the first unit, to 30% on the second, and finally to 5% on the third. The model of instruction described as mastery learning is summarized in greater detail in the section on Models of School Learning.

Prescriptive theory. Merrill, Reigeluth, and Faust (1979) have described a prescriptive theory of instruction aimed specifically at instructional quality. Instructional quality is defined as "the degree to which instruction is effective, efficient, and appealing -- that is, the degree to which it works in cost-effectively promoting student performance on a posttest and student affect toward learning" (p. 165). Quality of instruction depends upon both the adequacy and the consistency of three factors: specification of the instructional objective; coverage of concepts, principles, and procedures in the instructional presentation; and the match between the content presented and content tested. The adequacy of the instructional presentation depends upon the strategies used. Ideally it includes providing immediate informative feedback; isolating the skill to be taught from other material and clearly labeling it; giving cues and aids (mnemonic aids, attention focusing, and rules); providing an adequate sampling of examples; indicating differences in the examples; and using a range of difficulty levels. Merrill and colleagues have developed the Instructional Quality Profile, which is a set of detailed procedures for evaluating the quality of the instructional presentation in relation to different kinds of objectives and test items.

Case's theory. Case (1978) proposed that achievement can be improved by designing instruction that uses principles derived from the study of cognitive development, specifically those related to children's strategy use and working memory. He argued that effective instruction must both demonstrate to the student that his/her current strategy is inadequate and minimize the memory requirements of acquiring a new, appropriate strategy for the skill being taught. Five general principles of instructional design, aimed at reducing the learning difficulties of young children, use the concepts of diagnosing current strategy use, presenting the instructional goal and several examples highlighting appropriate and inappropriate strategy use, focusing student attention, and modifying for the role of prior learning. With regard to minimizing the demand on the student's working memory, Case contends that instruction must reduce to a bare minimum the number of items requiring the student's attention, ensure that cues to which the student must attend and all required responses are familiar, and ensure that cues or items to which the student must attend are salient.

Rothkopf's theory. Rothkopf (1981) is interested in the conditions that promote learning, specifically whether a designated learning objective has been attained. He theorizes that instructional materials relevant to the student's experience, congruence between the instructional presentation and the learning objective, controlling for the cognitive burden of the information to be learned, and modifying for the processing and capacity limitations of the student are the conditions critical for promoting positive academic outcomes.

Instructional Stages

Many individuals advocate that instruction should be designed to include different levels or stages. Various terms are used to describe the sequence of instructional events or activities from introduction to practice and application to review. These terms include learning hierarchy (Gagne & Briggs, 1979), phases (Hunter, 1979), levels of presentation (Hudson, Colson, & Braxdale, 1984), and instructional hierarchy (Haring & Eaton, 1978). In this section, the instructional hierarchy views of Haring and Eaton (1978) and Hudson and colleagues (1984) are included because of their relevance to designing effective instruction for low achievers. This is followed by a summary of Norman's (1978) theory of learning, a theory that contributes to an understanding of how a student's attention or time on task varies during different instructional stages.

Designing effective instruction. An instructional hierarchy, comprised of acquisition, fluency building, generalization, and application or adaptation, was initially hypothesized as important for instructing low achievers, and later confirmed by research (Haring & Eaton, 1978). Haring and Eaton contend that no skill is used instantaneously and that distinctly different types of learning occur in the development of a skill as it proceeds through the four stages. Acquisition (Stage 1), spanning from the first appearance of the desired behavior to reasonably accurate performance of the behavior, emphasizes obtaining accuracy rather than speed of response. Instruction during the acquisition stage is characterized by demonstration (teachers accurately performing a skill), modeling (presenting an example of a skill or a pattern of response to follow), cues, and routine drill. Fluency building (Stage 2),

ranging from acquisition to proficiency, emphasizes speed of response and aims to ensure maintenance. Instructional strategies for fluency building involve repeated novel drills and reinforcement activities (i.e., practice). Drill and practice are differentiated on the basis of whether the goal is acquisition or maintenance. Practice and drill are necessary to form rules and associations, which are the basis for future generalizations. Generalization (Stage 3), which uses discrimination training, emphasizes performance of a skill in response to new stimuli similar to those used during instruction. Application or adaptation (Stage 4) involves modification of learned skills to the varying demands of the new task. Problem solving activities and simulations are appropriate instructional procedures to teach students to adapt responses. The authors stress that the teaching goal and instructional procedures need to vary according to a student's placement in the instructional hierarchy.

The importance of an instructional hierarchy also has been applied to instructional planning for dysfunctional learners by Hudson and colleagues (1984). The authors contend that the student's learning readiness dictates the presentation level appropriate for instruction. Six levels of presentation are identified: awareness, recognition, recall, application, maintenance, and generalization. Contrary to Haring and Eaton's instructional hierarchy, the levels in this instructional sequence are interactive and are not considered as individual entities or as developmentally hierarchical.

Time on task and instructional stages. Norman's theory of complex learning, with three modes for acquiring knowledge, is reviewed by Bennett, Desforges, Lockburn, and Wilkinson (1984) in their discussion of the quality of students' learning experiences. The mode of acquisition, called accretion, is

simply the addition of new information either within or guided by existing knowledge structures. The second mode, called restructuring, is characterized by new insights or associations within the existing knowledge structure. While Norman believes restructuring is the most important learning phase, it is the most infrequent and most difficult to produce. Restructuring requires good teaching, such as examples, appropriately selected analogies and metaphors, and it is necessary to test conceptual understanding. The third mode, called tuning, is the performance of a task or skill until automaticity is reached. The different modes do not necessarily occur in sequence. According to Norman, "presumably they co-occur, with the student accreting knowledge of a topic while simultaneously restructuring knowledge about other aspects, and conceivably tuning the use of the knowledgeable skill of a third aspect" (p. 42).

Norman has hypothesized that time on task required during the study of a complex topic varies significantly with the mode. In addition, students learn several skills simultaneously. Norman hypothesizes that while learning complex tasks, the student's time on task may need to be high for a skill in the accretion mode, lower for a skill in the restructuring mode, and very low for a different skill in the tuning mode.

Models of School Learning

Time has been a topic of interest and concern to educators for almost a century (Rice, 1897). During the past decade, extensive conceptual and empirical work on time-based instructional variables has been conducted. This research has been closely associated with work on instructional effectiveness. According to Fisher and Berliner (1985), these research areas provide a framework for characterizing effective instruction in elementary schools. In

this section, the work on time-based variables, and the various models that have been developed from time-based research, are discussed. Six models of school learning are described, with particular emphasis on views of instructional effectiveness within each model. Similarities and differences among the models are discussed.

In addition to Carroll's (1963) model of school learning, the models of school learning included here are mastery learning (Bloom, 1976), a model for determining pupil achievement (Harnischfeger & Wiley, 1977, 1985), a model of classroom processes (Cooley & Leinhardt, 1980), a model of classroom instruction (Fisher, Berliner, Filby, Marliave, Cahen, & Dishaw, 1980), and a dynamic view of classroom learning (Karweit, 1983). Different facets of the teaching-learning process are emphasized within each model. However, each model is derived from Carroll's model of school learning. These models make the implicit assumption, to a greater or lesser degree, that "time is a critical factor in determining the degree of achievement and, subsequently, that individual differences in time needed to learn are related to variation in achievement" (Gettinger, 1984, p. 18). The interested reader is referred to summaries of models of school learning by Kavale and Forness (1986) and Leinhardt (1980), and to two comprehensive books on the role of time in school learning edited by Anderson (1984b) and Fisher and Berliner (1985).

Carroll's Model of School Learning

The relationship of time and learning has been a topic of interest since the seminal work of Carroll (1963). In his model of school learning, the degree of learning equals the time actually spent learning divided by the amount of time actually needed to learn (see Figure 1). These time variables are defined

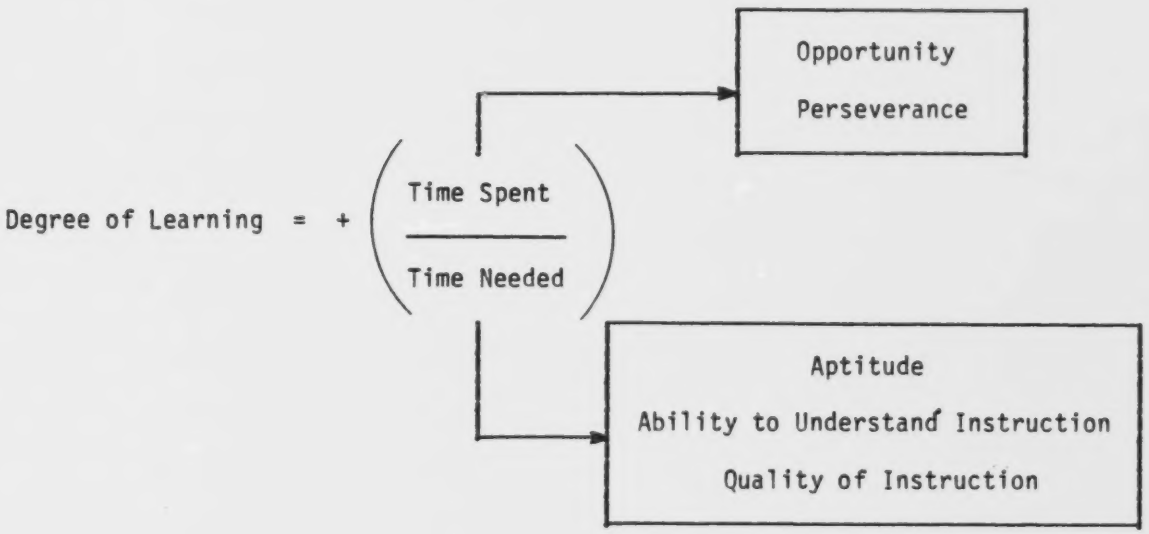

Figure 1. Carroll's Model of School Learning

in terms of the learner's active learning, not the elapsed time actually or potentially taken by a learner to complete a task. Carroll's model involves five elements; they are described under two headings: (1) determinants of time needed in learning, and (2) determinants of time spent in learning.

Time needed in learning. The amount of time needed depends upon three factors: aptitude, ability to understand instruction, and quality of instruction. Aptitude, which is redefined as a function of time by Carroll, is the amount of time needed to learn a task under optimal instructional conditions. "Optimal conditions" refers to both student perseverance and opportunity to learn a specific task to a specified criterion of success. Aptitude is defined as the student's learning rate when, and only when, all factors are optimal. The shorter the time needed for learning, the higher the student's aptitude. Carroll cautions that a student's aptitude is specific to the task under consideration and is a function of numerous other variables. It may depend upon the amount of prior learning for a specific task or upon student characteristics that vary with a variety of tasks. Thus, Carroll speaks of "aptitude for learning this task" (Carroll, 1985, p. 63).

Ability to understand instruction is seen as a function of the student's general intelligence and the adequacy with which the task is presented. Quality of instruction is a measure of the degree to which instruction is presented so that it will not require additional time for mastery beyond that required given the student's aptitude. Quality instruction results in the student learning as rapidly and efficiently as he/she is able. According to Carroll, this means (a) the student must be told in comprehensible language what is to be learned and how to learn it, (b) the student must adequately see and hear materials to be

learned, (c) the tasks must be carefully sequenced and detailed so that each step of learning provides an adequate basis for the next step, and (d) instruction must be adapted for the student's special needs or characteristics, including his/her stage of learning. In this model, quality of instruction varies according to the clarity of task demands, adequacy of task presentation, adequacy of subtask sequencing and pacing, and the degree to which the learner's needs and characteristics have been considered during the instructional presentation. Quality of instruction applies to instructional materials (textbooks, films, teaching-machines) and the performance of the teacher.

There is an inter-connectedness for the three determinants of time needed to learn. If the quality of instruction is less than optimal, some students may be handicapped by poor instruction. The extent of this handicap is influenced by the student's ability to understand instruction. Students with high ability will be able to overcome difficulties created by poor quality of instruction. Therefore, the amount of time needed to learn a task is a function of aptitude and quality of instruction; the amount of additional time needed is an inverse function of the student's ability to understand instruction.

Time spent in learning. The amount of time spent in learning is influenced by opportunity and perseverance. Opportunity refers to the time allowed for learning and involves "officially" scheduled time by school districts as well as the amount of time allowed by teachers and instructional programs. Therefore opportunity involves time allocated to the task and time allowed for task learning. Perseverance is the amount of time the student is willing to engage actively in learning. It is a measure of the student's task involvement. Carroll is interested in "perseverance-in-learning to criterion"; the student

needs to have a marked willingness to spend time, withstand discomfort, and face failure. Perseverance-in-learning is conceived of as a function of motivational and emotional variables.

The complete model involves five elements -- two stemming from external conditions (opportunity and quality of instruction) and three residing in the individual (aptitude, perseverance, ability to understand instruction). Three of the factors are expressed easily in terms of time: opportunity is the amount of time allowed for learning, perseverance is the amount of time the student is willing to persist in learning, and aptitude is the time needed to learn. Ability to understand instruction and quality of instruction are elusive qualities in this model, but are believed to have an impact on aptitude. Time needed to learn is increased by whatever amount is necessary to compensate for lack of ability to understand instruction and poor quality instruction.

Cautionary remarks. Carroll's model was proposed with the hope that educational psychologists could state parameters for different types of learning by students with different characteristics under defined instructional conditions. The model is thought to contain every element required to account for a student's success or failure in school (Carroll, 1985), even though precise measurement of the five elements has eluded educational researchers (Gettinger, 1984b). An understanding of the five elements results in estimates of optimal student learning. For example, if a student needs two hours to learn (aptitude, quality of instruction, ability to understand instruction), and the teacher allows one hour (opportunity), but the student spends 30 minutes (perseverance), only 25% of optimal learning has occurred. According to Harnischfeger and Wiley (1985), Carroll's original intent in formulating the

model was to clarify the role played by aptitude in achievement and to specify how instruction affects that role.

While the model is comprehensive, it should not be confused with learning theory, which Carroll (1985) views as "exact scientific analysis of the essential conditions of learning and the development of systematic theory about this process" (p. 62). Carroll's model assumes learning occurs; learning is a "given." The model is a description of the efficiency of the school learning process or the degree of learning.

Effective instruction. In Carroll's model of school learning, effective instruction is best illustrated by the actual time spent in school learning and quality of instruction. Effective instruction is characterized by high rates of academic engaged time (not allocated time) or "the time during which the person is oriented to the learning task and actively engaged in learning.... It is the time during which he (the learner) is 'paying attention' and 'trying to learn'" (Carroll, 1963, p. 725).

Carroll's definition of quality of instruction emphasizes the nature, objectives, content, and hierarchical structure of teacher-provided instruction and instructional materials. He states that in effective instruction:

> The learner must be told, in words he can understand, what he is to learn and how he is to learn it.... He must also be put into adequate sensory contact with the material to be learned.... The various aspects of the learning task must be presented in such an order and with such detail that, as far as possible, every step of the learning is adequately prepared for by a previous step. It may also mean that the instruction must be adapted for the special needs and characteristics of the learner, including his stage of learning. (1963, p. 726)

While Carroll recognizes that other factors, such as motivational strategies, teacher enthusiasm, interesting lesson presentation, feedback and correction,

and praise are important characteristics of effective instruction, he places primary emphasis on the nature, objectives, content and structure of instruction.

Bloom's Mastery Learning Model

Bloom retained Carroll's emphasis on both quantity of time and quality of instruction. He transformed Carroll's conceptual model into an instructional paradigm called mastery learning. His model is comprised of three basic constructs: student characteristics, the nature of instruction, and the nature of outcomes (see Figure 2).

Within student characteristics, Bloom specifies two types of prerequisites for efficient learning: cognitive and affective entry behaviors. Cognitive entry behaviors may be either general (e.g., intelligence) or specific (e.g., prior knowledge of a learning task). Affective entry behaviors also are general (e.g., self-concept, attitude toward school) or specific (e.g., attitude toward a curriculum area or a specific task) and correspond to Carroll's notion of perseverance. Nature of instruction refers to matching instruction to student's entry level behaviors; the use of instructional cues, feedback, and correctives; degree of reinforcement; degree of student participation; and timing. The issue of when time is spent on these activities, that is, the timing of initial instruction, timing of correctives, timing of guided practice, and timing student progress into the next task is a critical feature of the model. Bloom specifies three learning outcomes: achievement, affective, and rate of learning. Learning outcomes are viewed as a function of the quality of instruction and the student's cognitive and affective entry behaviors, particularly the degree of consideration of student characteristics during the teaching-learning process.

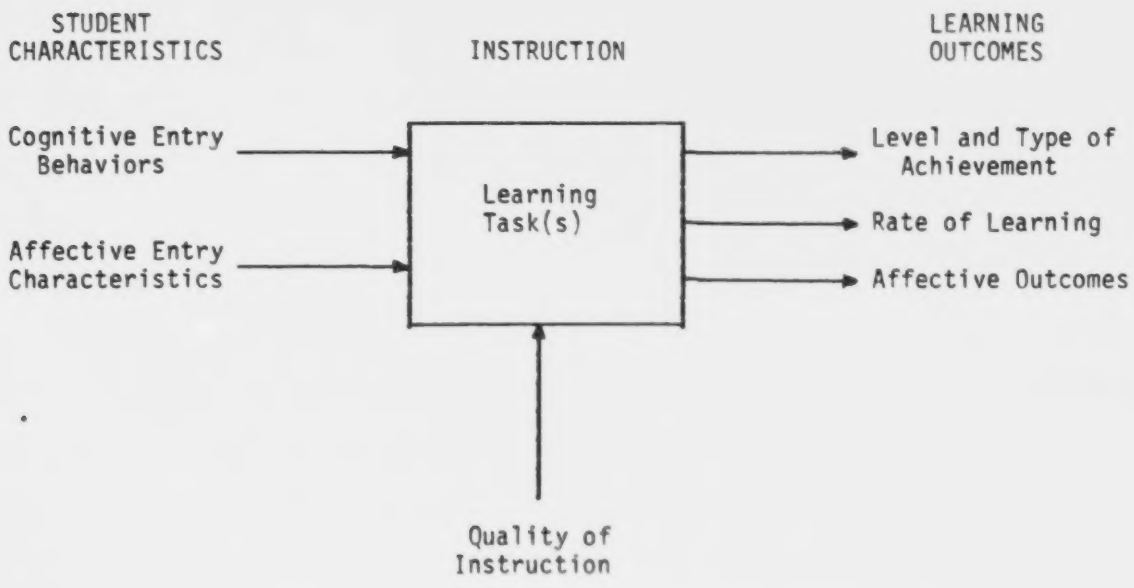

Figure 2. Bloom's Theory of School Learning

Bloom reiterates the importance of Carroll's five factors and refers to them as the variables for mastery learning strategies (Bloom, 1985). His assumptions and beliefs regarding the role of aptitude, quality of instruction, student ability to understand instruction, perseverance, and time allowed for learning are highlighted here.

Aptitude. Bloom supports Carroll's view that aptitude is the amount of time necessary for the learner to attain mastery of a learning task. He recognizes that students differ in their aptitudes for particular kinds of learning. Aptitude for particular learning tasks is not completely stable; aptitudes may be modified by appropriate environmental conditions or learning experiences in school or home. Aptitudes are predictive of rate of learning rather than the level (or complexity) of learning that is possible. Bloom assumes, therefore, that given sufficient time and appropriate types of help, all students can conceivably attain mastery of a task. He identifies this belief as having the most fundamental implication for education. He states that "the major task of educational programs concerned with learning to learn and general education should be to produce positive changes in the students' basic aptitudes" (1985, p. 79).

Quality of instruction. Bloom makes the assumption that individual differences in learners are related to variations in quality of instruction. In his model, it is accepted that some students may need more concrete explanations, examples or demonstrations than others; some students may need more approval and reinforcement than others; some students may need several repetitions of the lesson presentation while others may understand it the first time. Tutoring has been recommended as the vehicle for enabling students to

master particular tasks or subjects, because of the underlying assumption that it uses instruction best suited to the individual student's need and thereby maintains student motivation. Tutoring symbolizes Bloom's essential point about quality of instruction, that is, that quality of instruction must be considered in terms of "its effects on individual learners rather than on random groups of learners" (1985, p. 80). Bloom is interested in the kinds of instruction needed by different kinds of learners.

Ability to understand instruction. Bloom emphasizes student understanding of the task presented. He believes most students are able to understand instruction if they (a) understand the nature of the task to be learned, and (b) understand the procedures to follow in learning the task. Since schools primarily use group instruction, he contends that instructional modifications are necessary to help individual students at selected points in the learning process. Techniques for modifying instruction to fit the differing needs of students include group study procedures, alternate instructional materials, and tutorial help. The essential point is that there are attempts to improve the quality of instruction in relation to the ability of each student to understand the instruction.

Perseverance. Bloom believes students' perseverance varies with the learning task presented. Although he recognizes the role of student interest and affective factors in student achievement, he underscores the essential role played by quality of instruction in reducing the amount of perseverance necessary for a given learning task. Improvements in the nature of instruction, such as frequency of feedback, adequacy of explanations and illustrations, and kind of instructional resources, are key ways to increase the proportion of students who can persevere to mastery.

Time allowed for learning. Bloom believes each student should be allowed the time he/she needs to learn a subject or task. Time needed to learn is determined by a specified level of criteria and is influenced by the student's aptitudes as well as the quality of instruction received in class and quality of help received outside of class. The mastery learning model focuses on finding ways to alter the time individual students need for learning as well as finding ways of providing the amount of time needed by each student. In Bloom's mastery learning model, solving both instructional and school organizational problems is important.

Effective instruction. Bloom (1985) considers quality of instruction in terms of its effects on individual learners rather than on random groups of learners. While he has identified some essential characteristics of instruction, he believes the kind of instruction needed may vary for different types of learners. Specifically, Bloom is interested in the time needed to learn a particular task by individual students. He states:

> The task of a strategy for mastery learning is to find ways of altering the time individual students need for learning as well as to find ways of providing whatever time is needed by each student. Thus, a strategy for mastery learning must find some way of solving the instructional problems as well as the school organizational (including time) problems. (1985, p. 85)

Effective instruction is mastery learning, which is characterized by (a) accurate assessment of students' prior knowledge and skill level, (b) the specification of objectives and content of instruction to inform both teacher and students about the expectations, (c) breaking instruction into smaller units and explaining and ordering the task in an optimal way for students, (d) provision of appropriate cues, active student participation, and use of frequent, explicit feedback and correctives, and (e) setting standards of

mastery or predetermined outcomes. According to Bloom, effective instruction is instruction in which students' instructional needs are diagnosed and instructional materials or processes are prescribed to help correct their difficulties. The learning of students is paced by frequent formative evaluation which helps motivate them to put forth the necessary effort. Bloom believes that the setting of mastery standards must avoid interstudent competition; students must feel they are being judged in terms of level of performance rather than against a normal curve or arbitrary set of standards.

When students' prior knowledge is assessed, appropriate cues are provided, student participation is enhanced, and feedback and correction are provided, Bloom believes students learn to learn more effectively; they become more efficient in their learning. According to the mastery learning model, the amount of time on task accounts for achievement variation. Bloom argues that as instruction proceeds, the percent of time on task may be determined primarily by student achievement on preceding units, student interest in the subject, and the quality of instruction. He tentatively concluded that "time-on-task is almost as well predicted by indices of these variables as is level of achievement the student attains" (Bloom, 1973, p. 686).

Harnischfeger and Wiley's Model

Harnischfeger and Wiley began their research on the relationship between time and pupil achievement over a decade ago (Harnischfeger & Wiley, 1976, 1980, 1985; Wiley, 1973; Wiley & Harnischfeger, 1974). Their current model of the teaching-learning process is heavily influenced by the work of Carroll (1963) and Bloom (1974). Development of their model began with the recognition that learning requires spending time to learn, pupil achievement is determined by

pupil learning pursuits, and pupil learning pursuits are formed through teaching. Their early research used a crude indicator of learning time, that of quantity of schooling offered, measured in hours per year. Their subsequent research focused on a more comprehensive, extensive conceptual framework of the teaching-learning process that delineated the determinants of active learning time. Harnischfeger and Wiley's model is unique because of its delineation of the determinants of active learning time and the conceptual distinction between activities that reduce time needed for learning and those that increase active task learning time.

Harnischfeger and Wiley (1985) believe that students' time on task (active learning time, academic learning time, engaged learning time) determines their achievements. Their recent research has been directed toward answering "How can we maximize students' active learning time?" by focusing on modifiable determinants of students' active learning time. Although the key concept of this model is active learning time, the centrality of the student's participation in the learning process does not mean it is sufficient to focus only on student participation. Rather, all of the activities of educators -- including administrators, teachers, and supporting staff are relevant to improving student participation. Thus, in their model, which appears in Figure 3, elements from all levels of the educational environment are examined.

There are many determinants of students' active learning time, including community, school board, school teaching staff, class members, teaching activities, and student characteristics. In Harnischfeger and Wiley's model, it is rcognized that students' actual learning experiences are influenced in general by the broader educational context and in particular by two factors:

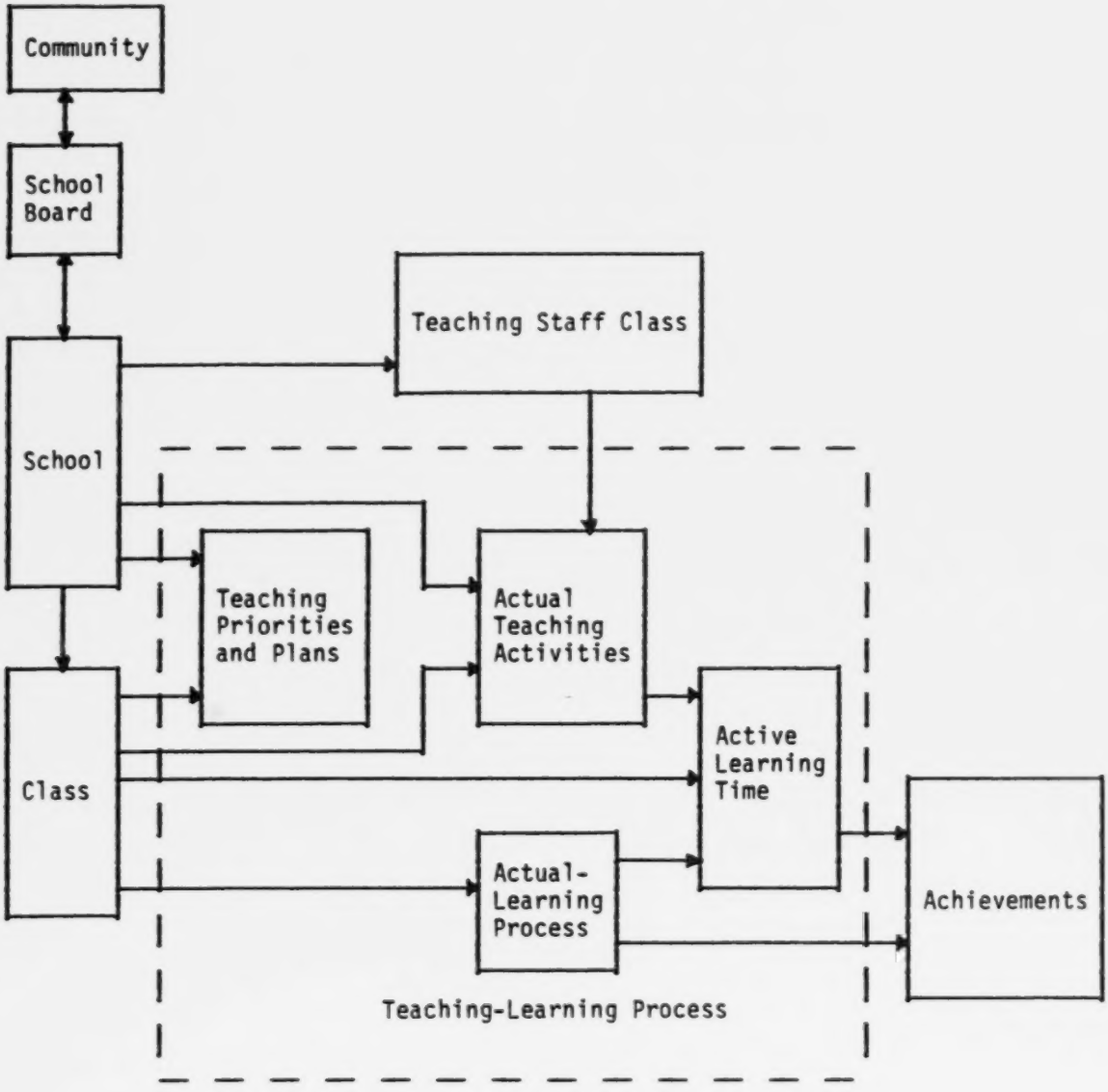

Figure 3. Harnischfeger and Wiley's Teaching - Learning Process

resource allocation and loci of control. For example, policy decisions regarding pupil, teaching, and administrative assignments, expenditures for equipment and teaching supplies, and curricula are made at many levels beyond the teacher's control (including decisions at the school level, the school board level, and the community level). Yet, these decisions influence students' learning experiences. While community, school board, and school level decisions influence students' active learning times, teaching activities and pupil pursuits are considered the major determinants of active learning time.

In this model, teaching activities determine students' opportunities to learn and their active learning times. The teaching activity component is subdivided into teaching priorities and plans and actual or implemented teaching activities. The structure of teaching activities is a function of plans; it is constrained by such elements as student characteristics, teaching materials available, curricula guidelines, rules and policies of the school district, and planning skills of the teacher. Activities are planned by considering four elements: (1) grouping and supervisory strategies, (2) selection and organization of learning tasks (content, complexity, sequencing, pacing), (3) setting of performance standards, and (4) allocation of time to learning tasks. In general, grouping and supervision are determined by students' cognitive capabilities and motivations; grouping influences selection of learning tasks, which allow for performance standards to be set. Finally, timing priorities are made.

The kind of learning activity that is actually implemented in the classroom depends on the teacher's management of learning tasks (e.g., transition times, performance standards for task completion), actual times allowed for learning

tasks, management of pupil learning involvement (e.g., monitoring, motivating student pursuits), and communication about the learning tasks and their demands (includes textbooks and materials). Believed to be determined by teaching plans and priorities, management of learning tasks, along with clarity of rules and procedures, influences actual time allowed for learning. In contrast, management of student involvement and communication of task demands are less influenced by teacher plans but greatly influenced by motivational strategies and presenting skills of the teaching staff.

According to this model, pupil pursuits (i.e., student involvement) are guided by the teaching process. Learning involves both the understanding of task requirements (time needed for learning) and the actual active task learning time (time actually spent). Harnischfeger and Wiley make a conceptual distinction between active learning time and time needed for learning. They argue that depending on the teaching circumstances or strategy, differences in percent of time on task result from either reductions in time needed or from increases in active learning time. Different teaching activities determine these outcomes. Monitoring and motivating teaching activities influence time devoted to understanding of task demands and active task learning time. However, clarity of communication directly affects only the time needed to understand task requirements.

Effective instruction. According to Harnischfeger and Wiley (1985), effective instruction, defined as optimal student achievement, is achieved by reducing the time needed to learn or increasing students' active learning time. They focus on increasing students' active learning time and suggest three ways to do so: (1) increase the total amount of time allocated to learning, (2)

increase the portion of allocated time that is actually allowed for learning, and (3) increase the amount of this allowed time that students are actively engaged in learning.

These three ways are influenced by more than the teacher; procedural and curricular policies of districts and schools have a major effect on students' active learning time. Three points related to this are suggested by their model. First, direct increases in allocated time are entirely the outcomes of district and school level policies. The second point asserts that increasing the portion of allocated time that is used for learning is a function of both the teacher's classroom management skills and school level support for classroom management. To maximize learning time the teacher must be skilled at instructional organization and behavioral management and the school must support the teacher by reducing unnecessary interruptions. Finally, increasing the amount of time that students are actively engaged in learning is influenced solely by the teacher's effectiveness in monitoring and maintaining student task involvement. The Harnischfeger and Wiley (1985) model underscores the importance of stating instructions and expectations clearly, motivating students through task involvement, and a high degree of teacher-student interaction. In addition, it suggests that effective instruction is influenced by variables beyond the classroom.

Model of Classroom Processes

The model of classroom processes (Cooley & Leinhardt, 1975), used in the Instructional Dimensions Study, was designed as a guide for evaluating the instructional environment, rather than as a prescription for instruction. The model appears in Figure 4 and is comprised of constructs with embedded

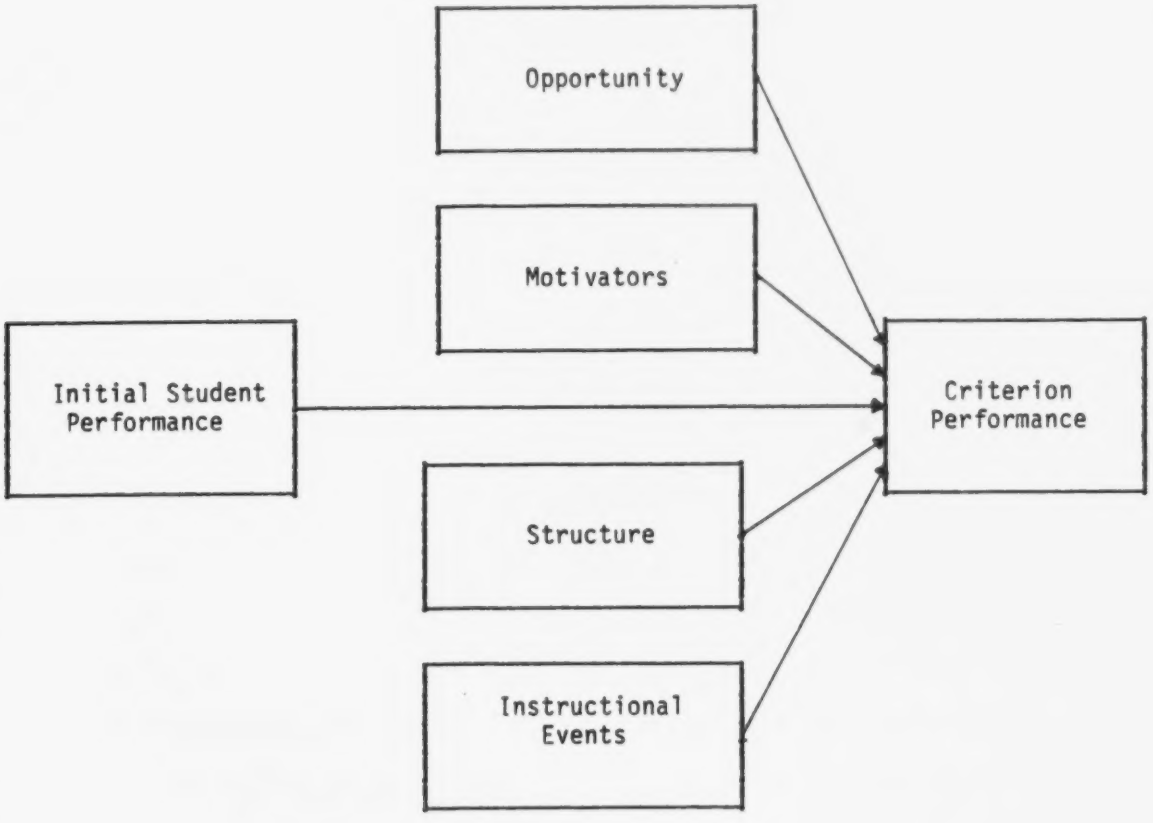

Figure 4. Model of Classroom Process

variables. According to this model, students' performance is a function of initial student performance and of specific classroom processes. The classroom processes are represented by four constructs: opportunity, motivators, structure, and instructional events.

While student achievement is acknowledged to be a function of initial student characteristics and specific classroom processes, the emphasis in this model is on what occurs during instruction. The opportunity construct contains two key variables: the use of instructional time in classrooms and the similarity of the curriculum to the tests (i.e., curriculum alignment or curriculum overlap). The motivators construct, intentionally not defined as a student attribute, includes aspects of the curriculum and in-class interpersonal behavior that encourage student learning. Structure, intended to be the materials and methods construct, considers the organization of the curriculum, the specificity of objectives, and the manner in which a student and a curriculum are matched. Intended as the teaching construct, the instructional events construct includes the content, frequency, quality, and duration of instructional interactions. The model does not specify the relationships among the four constructs.

Effective instruction. While the four constructs -- opportunity, motivators, instructional events, and structure -- are the defining characteristics of effective instruction in Cooley and Leinhardt's model, opportunity, which is comprised of time and curriculum overlap, was the most important predictor of reading and math achievement. Time is measured in varied ways, including attendance, school moves, allocated time, and on-task rate. While time spent in learning is a very important part of opportunity, curriculum

content also made a major difference. Students performed better on tests if they had been exposed to the content covered by the test and the form of the test items. Thus, the opportunity that students have to learn is the most important characteristic of effective instruction. Time itself is not the issue, it is what one is doing with the time -- or the degree to which students have an opportunity to learn that which is tested.

Model of Classroom Instruction

The purpose of the Beginning Teacher Evaluation Study (BTES) was to identify classroom conditions and teaching activities that promote student achievement in elementary schools. BTES research involved classroom observations over a 21-week period of 139 students from second grade and 122 students from fifth grade in reading and math classes. Observers collected data on several dimensions for an individual target student, including content of instruction, allocated time, setting, student behavior (engagement and success level) and instructional behavior provided.

A model of classroom instruction proposed by BTES appears in Figure 5. Within the model it is thought that, for an individual student, certain instructional processes lead to classroom learning, which is subsequently reflected in achievement test scores. Student aptitudes directly impact student learning and achievement test scores. A distinctive feature of this model is the specification of two measures of student learning: student classroom behavior and student achievement test scores. According to this model, student learning can be measured more directly and immediately by observing student classroom behavior. Academic Learning Time (ALT), a measure of student classroom learning using observable student

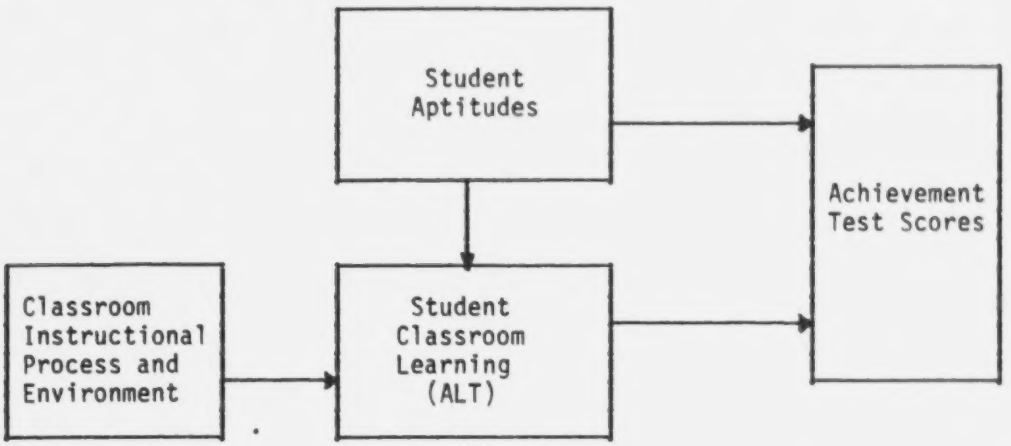

Figure 5. A Model of Classroom Instruction

of time actively spent by a student in an academic task he/she can perform with high success. The model contends that the nature of the tasks on which students spend time is as important as the act of engagement itself. Thus, the model broadens the concept of engaged time (time on task) by using student success rate as an indication of task appropriateness (Marliave & Filby, 1985).

Student learning is influenced by many variables. The match between the assigned task and the student's current knowledge influences the amount learned. Classroom instruction affects student learning by first affecting the observable classroom behaviors of a student. According to this model, five interrelated functions influence student learning (see Figure 6). Instructional planning involves two functions: diagnosis and prescription. Instructional interaction involves presentation, monitoring, and feedback. It is implied that the critical functions must be fulfilled, but there are numerous acceptable ways to execute them. Those chosen depend on classroom organization, curriculum, or teacher preferences. For example, diagnosis can be accomplished by listening to a child read, formal tests, or analysis of daily work. The model does not evaluate the effectiveness of different behaviors within each function, rather, the focus is on whether each critical function is fulfilled.

Classroom environment is globally defined to include such variables as enthusiasm, worth, competitiveness, cooperation, and task orientation. Differences in these environmental variables may influence ALT or may influence the relationship between teaching functions and ALT. For example, teacher feedback may be different in classrooms where the climate differs in warmth. Students may interpret feedback differently in these different environments, thus influencing student learning.

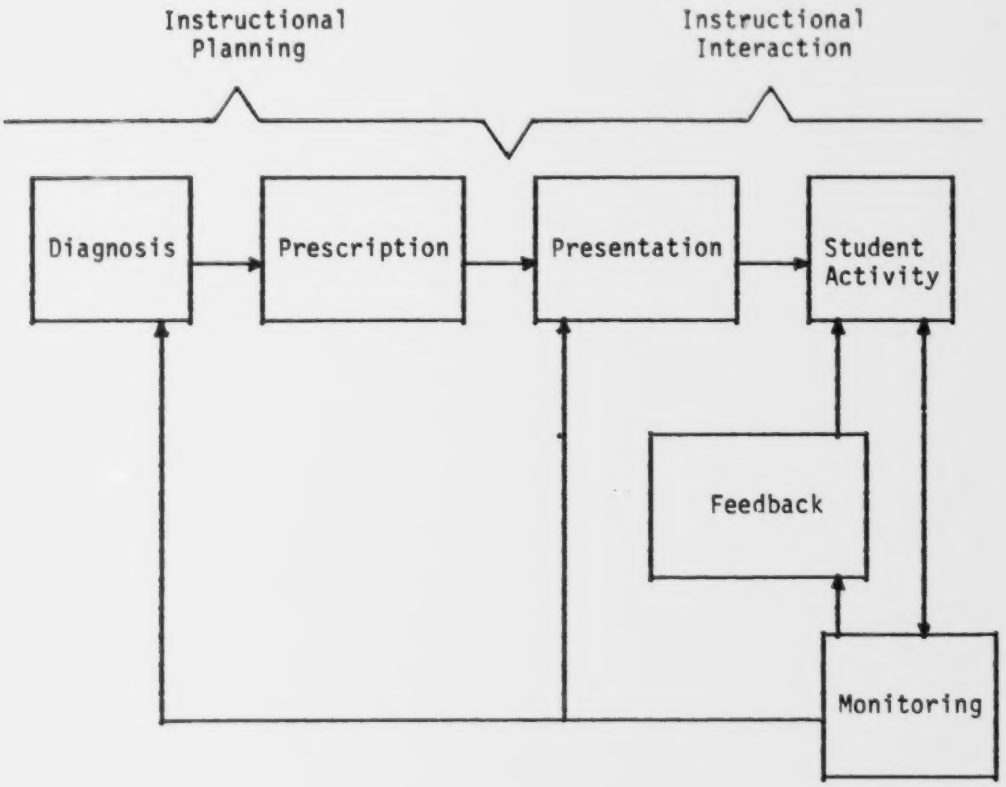

Figure 6. Instructional Functions

To summarize, ALT, an observable measure of student classroom learning, is the time spent by a student engaged in an academically relevant task that he/she can perform with high success. Teacher behaviors, categorized according to the instructional function they fulfill (diagnosis, prescription, presentation, monitoring, or feedback) have an impact on student achievement by affecting ALT (time allocation, engagement rates, success rates). In addition, the quantity of ALT is influenced by student aptitude as well as the total classroom environment.

Effective instruction. According to this model, effective instruction occurs when (a) teachers accurately diagnose student skill level, (b) teachers prescribe appropriate tasks, (c) substantive teacher-student interaction, teacher monitoring and explicit academic feedback exists, (d) clear, repetitive directions about task demands and information on the lesson structure are provided, (e) teachers establish an academic focus in the classroom, and (f) the learning environment is characterized by cooperation, student responsibility for academic work, and good behavioral control. Effective instruction is summarized by high rates of academic learning time (ALT), that is high amounts of time spent by a student on academically-relevant tasks that can be performed with high success. High success instructional performance does not require automaticity; rather, it can require considerable student concentration and effort, provided the student responds correctly, excepting "careless" errors.

A Dynamic Model of Classroom Learning

Although instructional time has played a central role in the development of the previous models of school learning, Karweit (1983, 1985) believes these models have not conceptualized the interdependence of teaching and learning.

According to Karweit, academic engaged time too often is viewed as the only important instructional variable for increasing student achievement. She argues that instructional time may have to be increased dramatically before having a noticeable effect on achievement. She estimates that to increase achievement by .25 of a standard deviation requires a 10 minute increase in engaged minutes for second and third graders. Since students are on task about 70% of the time, a quarter standard deviation increase in achievement requires that instructional time increase from 45 to 65 minutes daily. It may not be fruitful to expect such sizeable changes in learning time in order to foster achievement. Emphasizing the multiplicity of factors that influence student learning time, Karweit (1985) cautions:

> Because discussions of engagement with learning focus on the individual student, it sometimes inappropriately appears that the major source of variation in engagement is the individual student. However, student engagement is the final point in a long chain of educational events which produce variation in learning time. (p. 18)

She argues that while academic engaged time is a classroom event, it is affected by many decisions outside the purview of the actors, namely, the teacher and students. It may be that quality of instruction and the match to student skill level and rate of learning are more important factors than engaged time on achievement.

Karweit (1980) proposes a dynamic interactive view of learning in classrooms in which it is assumed that learning depends upon both student attention and appropriate instruction. These two elements, in turn, depend upon classroom organization variables, such as instructional pacing, grouping practices, student diversity, nature of the tasks, and the nature of curricular materials. In Karweit's model, the relevant variables are the characteristics

of teacher, learner, learning task, and pace of instruction (see Figure 7). This model views learning as the product of teacher and student effort on a learning task. The effectiveness of teacher and student efforts in producing learning is influenced by how much time is spent (duration effects), by when time is spent (timing effects), and by how time is spent (pacing effects). Teaching and learning have a mutually influencing effect upon one another and on other classroom organizational variables. The model assumes that the same amount of instructional time may have different results for different students, and for different learning tasks. The results of time spent depend upon the nature of the task or material to be learned, the pace of instruction, and timing of teacher-student interaction.

A key feature of this model is that instructional timing and pacing effects are important for student learning. Karweit assumes that students' learning rate is not constant but varies over time and is a function of teaching rate and the students' ability to learn at the presented rate (pace of instruction). Fluctuations in teacher effort, such as good or bad instructional presentation, smoothness of transitions, and fluctuations in student effort (boredom or interest in the topic) affect students' learning rates. Thus, the same duration of learning time may produce different results because of these fluctuations and because some ways of organizing instructional time may be more efficient for learning than are others.

The degree of cumulativeness or hierarchy of the subject matter being presented and the difficulty of the task are two task variables that determine pacing effects for student learning. Efficient instruction occurs when the student's knowledge level closely matches the teaching level. Instruction is

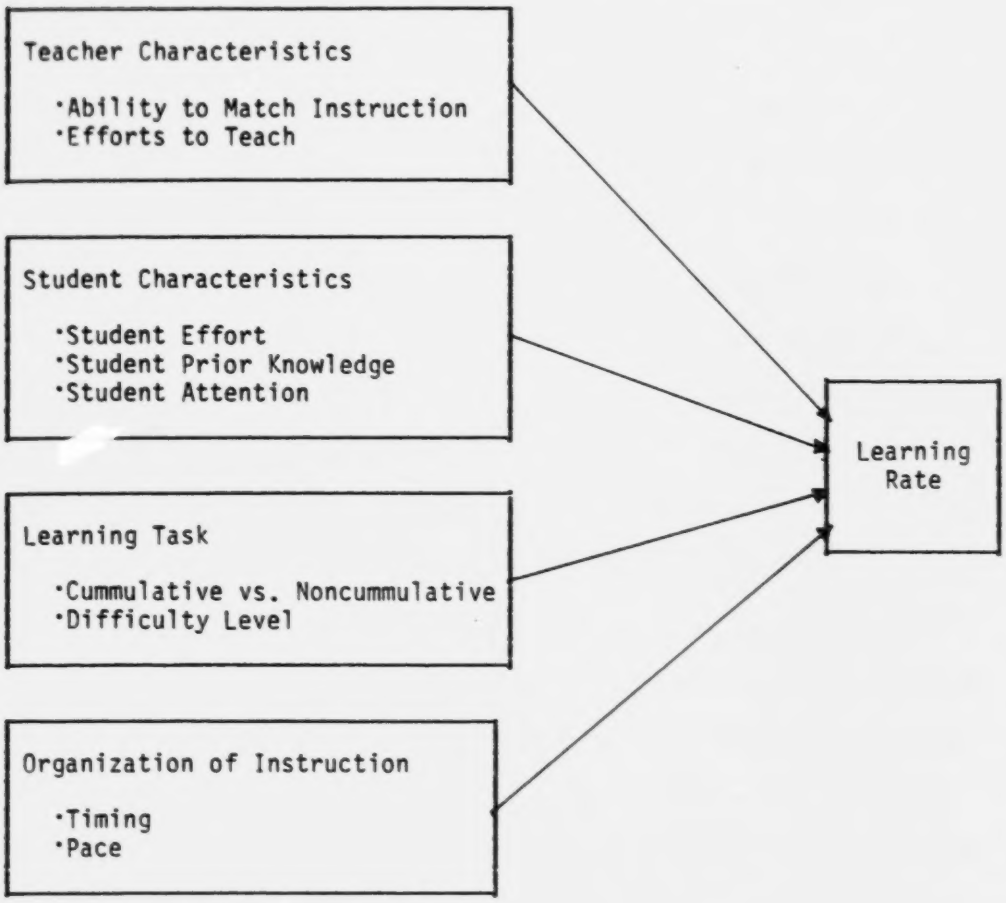

Figure 7. Dynamic Model of Classroom Learning

inefficient for students whose knowledge level is above or below the teaching level. The consequences of inefficient instruction depend upon the cumulativeness of the learning task; for a very cumulative learning task student efficiency in learning is reduced when the student knows more or less than what is expected. The student's learning rate is not so drastically affected by a noncummulative task, since the likelihood of the student learning is dependent on the student's ability to understand that step and not on knowledge of the previously presented material. Thus, the effects of time will vary according to the nature of the curriculum and will be different for different students within a classroom.

Karweit's dynamic view of classroom learning in general, and her notion of efficient instructional time in particular, underscores the complexity of understanding the teaching-learning process. In an attempt to accommodate student diversity, teachers often choose to individualize instruction. The advantages of increased learning efficiency through greater match of instruction to student need must be balanced against the increased loss of learning time that occurs from management tasks, transition times, waiting for assistance, and student attention during seatwork. Thus, the classic quandry! If the teacher assigns the same tasks to all students some will experience low success rates, while others will finish early. Students on either end may be "unengaged." However, if the teacher totally individualizes instruction, resulting in learning tasks appropriate to each student's level, a low rate of teacher-pupil interaction occurs. Each student in a classroom of 30 has limited contact with the teacher, potentially resulting in less active engagement for some students.

Effective instruction. Effective instruction is efficient; that is, students' learning rates are maximized. According to Karweit, the important

question about instructional time is "what is the effect of organizing learning time in specific ways?" not "What is the effect of a specific duration of learning time?" Karweit believes the complexity of the teaching-learning process for students can be understood only by considering how teachers make decisions about time use, how teachers group students for instruction, and how pace of instruction affects students' learning rates. Within this model, the productivity of the classroom is thought to be influenced by the organization of instructional time (specifically pacing and timing aspects of time use), in addition to efforts to learn by the student (student attention) and efforts to teach by the teacher (appropriate instruction). Classrooms are more or less productive depending on organization of classroom learning time in conjunction with the interaction of teacher-student-task factors.

A basic feature of the dynamic model of classroom learning is that the factors influencing the amount of learning can be expressed in terms of time. According to Karweit (1985):

> The difference between what the teacher expects and what the student knows can be expressed as the amount of time it takes to catch up. The degree of structure of the curriculum can be expressed in terms of the amount of time it takes for learning efficiency to be reduced. Transient effects such as interruptions, boredom, fatigue, and keen interest can be expressed by the amount of time they take up and by the amount of time needed to recover from them. Consequently, the events and factors that affect learning can be expressed in the same metric -- the amount of time required. Thus, knowledge of the time scales of various learning events is essential for developing realistic views of learning and for proposing how instructional time can be productively used. (p. 184)

Similarities and Differences

Similarities. The models are similar in at least three ways. In attempting to account for the critical variables in school learning, the models

all suggest that learning is the result of a complex amalgamation of factors, including student attributes (cognitive ability, affective characteristics), environmental influences (general family and educational environment characteristics) and instructional features (instructional design, teacher behavior, expectations, decision-making practices, classroom management and interaction, curriculum structure). In each model the variables affecting learning are expressed as a function of time, sometimes as the amount of the school year, length of the school day, time spent by the student, and so on. Each model implicitly or explicitly emphasizes that the amount of time spent is not the sole critical factor. Rather, amount of time actually spent by the student and congruence between time actually spent and amount of time required are essential aspects of time leading to student achievement gains. Finally, each model can be, and is, criticized for methodological weaknesses or for not completely explaining those factors accounting for variance in student learning. The thoroughness, yet incompleteness of the models, reflects the complexity of the teaching-learning process.

In addition to these general similarities among the six models, specific comparisons between various pairs of models yield more similarities. For example, teacher behaviors or teaching functions identified in the model of classroom instruction (BTES) are similar to the instructional events construct of the model of classroom processes.

Differences. The models are different in two general ways. While each model has expanded the determinants of Carroll's two time variables, each focuses at a different level. Bloom's mastery learning model and Carroll's model of school learning focus at the level of the individual student, while the

model of classroom processes (Cooley & Leinhardt, 1980) focuses on the classroom rather than the student. This model was designed as a guide to evaluate instructional environments not as a prescription for instruction. Karweit, in her dynamic model of school learning, focuses on individual student performance within the classroom context. Finally, Harnischfeger and Wiley present a model for determining school and student achievement by focusing on all levels of the educational environment.

Second, the models differ in emphasis on the interrelationship of the variables identified as important for school learning. In Carroll's model, the interrelationship of the five factors results in greater complexity than is perceived simply by the ratio of time spent to time needed in learning. Within both the model of classroom processes and the model of pupil achievements it is acknowledged that many variables effect student's learning and engaged time in the classroom, while within the model of pupil achievements variables that influence student achievement at all educational levels are specified. Karweit goes one step further. She argues that amount of academic engaged time is affected by many educational decisions outside of the teacher's purview as well as the interactive, mutually influencing effect of the teaching-learning process within the classroom. According to her model, characteristics of effective instruction (match to student need, pacing, feedback) are altered by the transaction of teacher efforts to teach and student efforts to learn. In contrast, both Bloom and the BTES model place more emphasis on identification of the key elements (i.e., an exact prescription) for learning and less emphasis on how these elements relate to each other or the larger educational context.

Differences exist at a more specific comparison level. For example, within the classroom process model it is assumed that initial student characteristics

influence teacher behaviors; within the BTES model this is not assumed. Differences between mastery learning and BTES models are discussed by Anderson (1984b). He notes that the orientation of the mastery learning approach is for the future needs of students whereas the BTES approach emphasizes the present needs of students. Mastery learning asks "What future tasks are students asked to perform," and "What future objectives are the students likely to be expected to attain?" In this approach, overall curricular goals are identified first, objectives and tasks are identified next, and students are placed appropriately in the sequence. The BTES approach asks "What are the current strengths and weaknesses of students? What tasks can be selected to ensure a high level of student success?" Although the two approaches emphasize careful sequencing of objectives and/or tasks, their differing orientations result in different conceptualizations of curriculum for a school. The mastery learning approach produces a single curriculum -- one for each group of students.

Also, Anderson (1984b) notes that within BTES and mastery learning approaches monitoring is identified as a characteristic of effective instruction. However, he contends that monitoring serves different purposes. In the BTES approach, maintaining the attention or task orientation of students is focused on, while within mastery learning, the monitoring of actual student learning vis-a-vis instructional objectives is of primary concern.

Implications for Characterizing the Nature of Instruction

The literature bases from both instructional psychology and the models of school learning areas contribute to the identification of important variables for promoting positive student learning outcomes. These variables, along with other areas identified from reviews of other knowledge bases, help in the

characterization of the nature of instruction. The major factors derived from each knowledge base reviewed in this monograph are highlighted here. The reader is referred to Monograph 7 (Ysseldyke, Christenson, & Thurlow, 1987) for a summary from all seven literature areas reviewed.

Instructional Psychology

Despite the varied terminology used by theorists and researchers in this area, there is agreement on many of the important variables or conditions necessary for promoting positive student learning outcomes. Principles of cognitive psychology and learning are viewed as important in explaining the effects of instruction. Many variables are believed to be under the teacher's control.

Lembo's (1969) factors arbitrarily have been selected to categorize those variables believed to be directed by teachers and supported by instructional psychology as important for increasing academic outcomes for students. They include:

Diagnostic Factor

- student's readiness for learning skill/content assessment
- student's prior knowledge/learning assessment
- cognitive demands of assigned task assessment

Prescriptive Factor

- presence of instructional goal or teaching objective
- carefully sequenced instructional materials (from simple to complex skills)
- clear communication of expected learning outcome
- consideration of level of instructional presentation

- flexibility in adapting to learner differences/background
- use of systematic instructional procedures:
  - focus student attention
  - teacher demonstration, modeling
  - isolatation and clear labeling of skill to be taught
  - learning guidance (student demonstration, informative feedback, prompts and cues)
  - match instructional presentation and teaching objectives
  - opportunities for practice, drill, generalization, application
- emphasis on student use of appropriate learning strategies

Normative Factor

- formative evaluation of student progress
- knowledge of results communicated to student
- match between content presented and content tested

Models of School Learning

The six models of school learning have contributed significantly to the educational knowledge base about characteristics of effective instruction and sound instructional practices. Critical instructional characteristics are identified within each model. In general, the characteristics can be summarized by the categories: instructional planning (diagnosis and prescription) instructional presentation (explanation, involvement) and monitoring (evaluation and feedback). Within the models, it is acknowledged that both engaged time and learning rates are influenced by the decisions made in the larger educational context and by student effort and cognitive involvement. Thus, the importance of student, teacher, classroom, and school variables in producing positive academic outcomes for students are recognized.

The primary contribution of models of school learning is the understanding that both quantity and quality of instructional time influence student

achievement. According to L. W. Anderson (1985), the concept of time in Carroll's model of school learning is critical yet widely misunderstood. He states:

> The model does not claim that time is the only variable in learning, or even the most important variable, as critics...seem to allege. Although several of the model's variables are expressed in terms of time, what goes on in that time is more important. Critics are confusing necessity and sufficiency: time is undoubtedly necessary, but not sufficient. (p. 7)

The importance of time-on-task (engaged time) is recognized, but there is no focusing on 'time' at the exclusion of 'on-task.' Acknowledging that "What goes on in that time" is difficult to explain, Anderson (1984a) suggests a portion of what goes on occurs in the head of the student and a portion goes on in the classroom. Consequently, the thoughts, feelings and attention of the student, the decision-making practices and effectiveness of the teacher, and quality of classroom activities influence the time that elapses during the school day. Doyle (1985) distinguishes between " time on activity" and "time on task." Time spent by students completing assignments unrelated to instructional goals, for example, is "time on activity," not "time on task." This time is unlikely to result in task accomplishment.

Summary

It is important to note that within both the instructional psychology literature and the literature on models of school learning, learning is addressed in general. There is no focus on learning problems or on students who are having difficulty learning in school. Certainly, however, their contributions to our understanding of the nature of the learning environment and to the identification of variables that are important to positive student

outcomes, are directly relevant to instruction for handicapped students. The variables identified by both literature areas should be considered when planning and implementing instruction for mildly handicapped students in mainstream and special education settings.

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